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# Biomass and Carbon Uptake of Mangrove Forests Pohorua Village, Muna Regency

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## Abstract

Environmental conditions caused by air pollution are so large that it impacts on changes in the ecosystem that affects all aspects of human life. Climate change is caused by increasing greenhouse gases in the earth's atmosphere because the Earth's atmosphere receives more carbon than it releases. This study aims to determine the potential of biomass and carbon uptake in mangrove stems in Pohorua village, Muna Regency. The research is quantitative descriptive, sampling using the Point Center Quarted Method (PCQM) technique measured around the height of the chest height mangrove tree (DBH). Data analysis was performed using an allometric equation in which each mangrove plant has a specific gravity. Carbon uptake found in mangroves stored in the roots, stems and leaves of mangrove plants, the results of the study showed that mangroves can absorb carbon quickly.

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Biomass,
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Mangrove forest,
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## Introduction

Management and utilization activities that are not matched by efforts to repair and maintain will result in reduced area of mangrove forests, because mangrove forests have a very important function as carbon sinks and storage. With the ability of mangroves to store carbon, the increase in carbon emissions in nature can be reduced. Mangrove forests have a key role in climate change mitigation strategies (Eddy et al. 2015) that report that the rate of degradation and loss of mangrove forests in Indonesia is classified as high, almost 50% - 60% of total mangrove forests in Indonesia have been lost due to various anthropogenic activities between others are fisheries, plantations, agriculture, logging, industry, settlement, salt ponds and mining.

The East Muna area, which is located in Pohorua Village, has the potential of mangrove forest resources that can be found almost along the coast with a length of ± 450 Ha. Overall with a small island For a long time, coastal communities have used mangrove forests for various daily needs. This resulted in an increase in the intensity of the exploitation of

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mangrove forests in the form of the use of mangrove wood as fuel resulting in the condition of mangrove forests in some places experiencing a decrease in both quantity and quality. The decline in the quality of mangrove forests in the area is thought to be caused by ongoing forest use activities that are carried out excessively without considering environmental sustainability. One form of utilization is the exploitation of wood as the main product of mangrove forests on a large scale for various purposes of building materials and firewood (Rakhfid et al., 2014).

Calculation of biomass is one important step that must be taken in climate change mitigation activities in the forestry sector to estimate carbon sequestration and reserves in a particular area. Therefore, this research is important to do because there are no data on biomass analysis and carbon uptake of mangrove forests in Pohurua Village, Muna Regency. The approach and strategy that will be achieved to the maximum to be used as supporting data so that the development and wise use of mangrove forests without damaging areas that are subject to development, such as ecotourism development.

## Materials and Methods

This study uses quantitative descriptive methods with data collection techniques in the form of primary data and secondary data. Primary data collection is done in two ways, namely calculating the density, biomass, carbon content and carbon uptake of mangrove species at the study site using the *Point Center Quarter Method* (PCQM) while secondary data are obtained from previous studies. This method is widely used to analyze forests that have dense densities (Indriyanto, 2010). Calculating aboveground biomass (rods) is done by a non-destructive sampling method by measuring the diameter of the stem at breast height (DBH 1.3 m) and then entering the stem diameter data into the allometric equation. This method is used to reduce destructive actions during measurement (Suryono et al., 2018).

### Data Analysis

**Surface biomass (stem)**

Determine the surface biomass (stem) using the allometric equation compiled by Komiyama et al. (2008) as follows :

$$\mathbf{BB = 0{,}251 \times \rho\, D^{2.46}}$$

Information :

$\rho$ = wood specific gravity (gram/cm$^3$)

D = diameter (cm)

Calculate the total biomass of all trees by adding up the biomass of all trees by the formula Hairiah et al. (2011):

**Total biomass of all trees = B1+B2+B3+................+Bn**

Information :

B1,B2,B3,.............,Bn = Biomass of each tree

**Carbon in Biomass**

Calculate carbon content in biomass using the formula Heriyanto et al. (2012):

**Carbon content = biomass x 50%**

Information :

50% = Percentage value of carbon content in biomass

**Carbon dioxide uptake ($CO_2$)**

Calculate carbon dioxide ($CO_2$) absorption using the formula Heriyanto et al. (2012):

$$(CO_2) = Mr.CO_2/Ar.\ C\ (\text{or } 3{,}67 \times \text{carbon content})$$

Information :

$CO_2$ = Carbon dioxide uptake

Mr = Relative molecular weight $CO_2$ (44)

Ar = Relative atomic molecular weight C (12)

## Results and Discussion

### Biomass

Analysis of the biomass potential and carbon uptake of mangrove trees is carried out non destructively by using a breast height (DBH) trunk diameter data approach which is then included in the allometric equation. The biomass value of each species in the study location is presented in Table 1.

**Table 1. Biomass value of mangrove species at each research station**

| Station | Species of Mangrove | Biomass (Kg/ha) |
|---|---|---|
| I | *Bruguiera gymnorhiza* | 732,25 |
| | *Avicenia alba* | 755,63 |
| | *Soneratia alba* | 2659,9 |
| | *Rhizophora mucronata* | 14460,13 |
| | **Total** | **18607,91** |
| II | *Bruguiera gymnorhiza* | 1163,58 |
| | *Avicenia alba* | 3517,36 |
| | *Soneratia alba* | 2474,01 |
| | *Rhizophora mucronata* | 3517,36 |
| | **Total** | **10672,31** |
| III | *Avicenia alba* | 3316,21 |
| | *Soneratia alba* | 2827,42 |
| | *Rhizophora mucronata* | 5904,15 |
| | **Total** | **12047,78** |

Biomass is a picture of the total organic material from photosynthesis to grow horizontally and vertically, causing an increase in tree diameter. The greater diameter of the tree is caused by the storage of biomass resulting from the conversion of $CO_2$ which increases more in line with the amount of $CO_2$ absorbed by the diatmosphere tree (Rahim, 2016).

Based on the analysis of total aboveground biomass potential on the mangrove tree trunk Rhizophora mucronata has the highest biomass of 23881.64 kg / $m^2$ and *Bruguiera gymnorhiza* has the lowest biomass value of 1895.83 kg / $m^2$. The estimated biomass value of each research station is station I at 18607.91 kg / $m^2$, station II at 10672.31 kg / $m^2$ and station III at 12047.78 kg / $m^2$. Station I has the greatest biomass value because the diameter of the tree and the number of individuals is greater than that of Station I and II. Another factor that causes the low value of biomass at the study site is the specific gravity of each species of mangrove tree. This is in line with what Sianturi (2018) estimates of the amount of biomass on land, especially trees, is influenced by tree diameter, specific gravity, tree height and soil fertility, causing differences in the amount of biomass and carbon stock in a vegetation. Rahman (2017) further stated that the biomass value of each mangrove species is different and is influenced by the ability of plant sequestration that can be analyzed based on the value of the density, tree diameter or height.

Plant biomass increases because plants absorb $CO_2$ from the air and convert these substances into organic matter through photosynthesis. According to Kedang et al. (2018) said that the biomass content in tree trunks had the biggest proportion compared to other tree organs because the composition of natural chemicals and extractive substances was greater than other tree organs so that the greater the diameter of the tree the value of the biomass content was higher.

### Carbon Uptake

Analysis of carbon uptake by converting carbon dioxide molecules then diverting carbon content in mangrove tree biomass. The carbon uptake values for each research station are presented in Table 2.

**Table 2. Carbon absorption values for each research station**

| Station | Species of Mangrove | Carbon Uptake (Kg C/ha) |
|---|---|---|
| I | *Bruguiera gymnorhiza* | 1343,69 |
| | *Avicenia alba* | 1386,58 |
| | *Soneratia alba* | 3873,67 |
| | *Rhizophora mucronata* | 25841,75 |
| | **Total** | **32445,69** |
| II | *Bruguiera gymnorhiza* | 25841,75 |
| | *Avicenia alba* | 2135,17 |
| | *Soneratia alba* | 4539,82 |
| | *Rhizophora mucronata* | 6454,35 |
| | **Total** | **38971,09** |
| III | *Avicenia alba* | 6085,24 |
| | *Soneratia alba* | 5256,8 |
| | *Rhizophora mucronata* | 10834,11 |
| | **Total** | **22176,15** |

Carbon content in plants illustrates how much the plant binds $CO_2$ from the air. Some carbon will be used as energy for plant physiology and enter into plant structures such as roots, stems, twigs and leaves (Syukri, 2017). Carbon is an element that is absorbed from the atmosphere through the process of photosynthesis and stored in the form of biomass. The level of carbon sequestration in forests is influenced by various factors including climate, topography, land characteristics, age and density of vegetation, species composition and quality of growing sites (Manafe, 2016).

Based on the research results of carbon absorption of *Bruguiera gymnorhiza* species of 27185.44 kg / $m^2$, *Avicenia alba* of 9606.99 kg / $m^2$, Soneratia alba of 13670.29 kg / $m^2$, *Rhizophora mucronata* of 43130.21 kg / $m^2$ and total absorption of mangrove carbon station I is greater than other stations with a value of 34145.53 kg / $m^2$ while the station that has the lowest total carbon uptake is found at station II with a value of 19906.16 kg / $m^2$. Carbon uptake at station I is greater than at station II and III, this is due to the percentage of carbon stock increasing in line with the increase in biomass. The greater the biomass content, the greater the carbon stock will affect carbon sequestration. This is due to several factors that affect the value of carbon stock including physical chemical factors of environment, density and type of substrate. In line with what was stated by Manafe (2016) The level of carbon sequestration in forests is influenced by various factors including climate, topography, land characteristics, age and density of vegetation, species composition and quality of growing sites.

The difference in the value of biomass and carbon content stored in various ecosystems depends on the diversity and density of plants and management of these ecosystems. According to Manafe (2016) the difference in stored carbon stocks is due to differences in the amount of diameter between the stands where the larger the diameter of the trees making up a land, the greater the weight of tree biomass on the land as well. Large biomass weight will affect the amount of carbon stock in a land. However, according to Yaya (2013) a high density does not guarantee the ability of carbon absorption and storage is high, but the absorption of $CO_2$ to become biomass is influenced by the work of enzymes in photodynthesis because each type has a different ability of photosynthesis. Species that have a sufficient density and ability to store carbon indicate that they are sufficiently able to adapt to environmental conditions and increase the success of rehabilitation efforts in the interests of climate mitigation.

The low carbon content value at Station II is due to local community activities that damage mangrove forests such as clearing land for ponds, roads and excessive mangrove wood harvesting without regard to environmental impacts. This is supported by the opinion of Senoaji (2016) that human activities play an important role in terms of increasing or decreasing the carbon content stored in mangrove ecosystems. Mangrove planting activities will increase stored carbon content, while cutting mangroves will reduce stored carbon content. *Rhizophora mucronata* type counts only 11 ind / $m^2$ at Station II because it is widely used by local communities for various needs such as the use of wood, natural dyes, medicine and others so that a large influence on stored carbon. This is supported by Restuhadi et al. (2013) that *Rhizophora mucronata* is used as fuel and charcoal, tannin from bark is used as a natural coloring agent and is sometimes used as a remedy for hematuria. The following is the physical condition of mangrove forest damage in the village of Pohurua, Muna Regency.

## Conclusions

Mangrove forest biomass potential in Pohurua village Muna Regency at station I was 18607.91 kg / $m^2$, station II was 10672.31 kg / $m^2$, station III was 12047.78 kg / $m^2$ and the total biomass value was 41612.23 kg / $m^2$ Mangrove forest carbon uptake in Pohurua village Muna Regency at Station I was 32445.69 kg / $m^2$, Station II was 38971.09 kg / $m^2$, Station III was 22176.15 kg / $m^2$ and total carbon uptake was 76358.45 kg / $m^2$.

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